

## Case Report

# A cadaveric study on variation in branching pattern of common carotid artery

<sup>1</sup>Romini Niranjana, <sup>2</sup>Sharma ST

<sup>1</sup>Department of Anatomy, Faculty of Medicine, University of Jaffna

<sup>2</sup>Department of Surgery, Faculty of Medicine, University of Jaffna

### Abstract:

Carotid arterial system are vessels of head and neck region. Comprehensive understanding on its branching configuration is of considerable importance to avoid accidental injury during surgical interventions. Common carotid artery (CCA) usually bifurcates into external carotid artery (ECA) and internal carotid artery (ICA) at level of upper border of thyroid cartilage. Normally ECA lies anteromedial to ICA at its commencement and provides branches, but ICA does not provide any branches in neck. In this case, right CCA bifurcated above cricoid cartilage and divided into two branches of equal diameter in a middle-aged female cadaver. Medial one does not provide any branch and it appeared pale. It continued upward, entered carotid canal and it was confirmed as ICA. The ECA was found lateral to right ICA both in its origin and course. ECA provided lingual, facial and occipital branches. Superior thyroid artery was not identified, and it might be accidentally damaged during dissection. It was noticed ECA was a content of carotid sheath. Vagus nerve first found between IJV and CCA and subsequently located between IJV and ECA. Third aortic arch contributed to development of CCA, leading part of ICA and entire part of ECA. Remaining part of ICA was developed from cranial portion of dorsal aorta. Therefore, any embryological deficiency in third aortic arch, dorsal aorta or changes inside of origin of ECA may lead to alteration in position of these vessels. Understanding vascular anatomy of neck is vital in precise interpretation of radiological images and neck surgeries.

### Key words

Branching pattern of common carotid, Reversed position, Internal carotid, External carotid,

### Introduction

Being the main nourishing arteries of the head and neck region, carotid arteries have distinct clinical significance. Carotid arteries require safety from accidental iatrogenic damage during surgical interventions, radiological assess-

ments and other invasive actions. Therefore, a comprehensive understanding on branching configuration of carotid arteries is of considerable importance in surgeries and other invasive techniques involved in the head and neck region.

The common carotid artery (CCA) usually bifurcates into external carotid artery (ECA) and internal carotid artery (ICA) at the level of upper border of thyroid cartilage (1). Normally the ECA lies anteromedial to the ICA at its commencement in the cervical region (2). The ECA passes under the submandibular and parotid gland and terminates as the maxillary and superficial temporal artery inside the substance of the parotid gland. The ECA provides the superior thyroid, ascending pharyngeal, lingual, facial and occipital arteries in the carotid triangle of the cervical region. Posterior auricular artery originates just above the carotid triangle. The ECA is the artery for the neck and the face region (3). The ICA is the artery for brain tissues and usually it does not provide any branches in the neck. The ICA is the frequent place for stenosis, atherosclerosis and aneurysm in the older population (4). Proper identification of the internal, external carotid arteries and knowing their course and distribution is of utmost vital importance for any surgeon operating in the neck region.

In the previous documented literatures, dissimilarities in the vascular composition of the neck especially carotid triangle have been reported. We report a variation in the branching pattern of CCA, which was identified in a cadaveric dissection.

### Case report:

In this case report, it was noticed that CCA bifurcated above the cricoid cartilage. It divided into two branches of equal diameter in which the medial one does not provide any branch in the neck and it appeared pale and continued upward and entered into the carotid canal and it is confirmed as the ICA (Fig 1). The lateral branch was identified as the ECA and it provides the branches: the lingual, facial and occipital arteries. (Fig 2). The superior thyroid artery was not identified and it might be accidentally damaged or injured during routine undergraduate dissection.

**Corresponding author:** Romini Niranjana. Email : [rominiranjana@yahoo.com](mailto:rominiranjana@yahoo.com).  <https://orcid.org/0000-0001-6647-1735>,

Submitted January 2022, Accepted July 2022



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution and reproduction in any medium provided the original author and source are credited

It was noticed the ECA was a content of the carotid sheath. The vagus nerve first found between the IJV and CCA and subsequently it located between the IJV and ECA (Fig 1). Thus it was concluded the positional changes in the two terminal branches of CCA (reversed position of ICA and ECA).

Fig 1 Right side anterior view of the neck



1 & 2 - Tracheal rings, 3 - Anterior arch of cricoid cartilage, 4- CCA, 5- ECA, 6 - ICA, 7- Vagus nerve, 8 - IJV, 9 - Thyroid tissue

Fig -2 showing the branches of the right external carotid artery



1- ECA, 2-ICA, a- Lingual artery, b-Facial artery, c-Occipital artery, d-Tendon of the posterior belly of digastric muscle, e-Hypoglossal nerve

### Discussion:

In this case, we observed the lateral origin and lateral position of ECA in relation to ICA. The ECA normally developed as a sprout from third aortic arch, mostly medial to ICA (5). The ICA developed from two different sources. The third aortic arch formed the leading part of ICA but the residual part of

the ICA was developed from the cranial portion of dorsal aorta (5).

Thus third aortic arch gives to the formation of the CCA, main part of ICA and the entire part of ECA. Therefore, any embryological modification in the third aortic arch, dorsal aorta or changes in the side of origin of ECA bud might lead to the alteration in the position of the ECA and ICA. In normal organization, the ECA initially located medial to the ICA at its origin level and later high up in the cervical region, the ECA appears to pass backward to ICA (6, 7).

If the ECA located lateral to ICA at its origin level generally at the bifurcation point of CCA can be infrequently transected during carotid endarterectomy (7). It was not unusual in the differences in the branching design of the aortic arches (8). Most of them were not related with any symptom and generally found as a secondary discovery during the usual investigative procedures (8).

A previous study out of 52 cadaver specimen, noted that 63.5% aortic arches presented traditional branching pattern and the residual showed dissimilarity in the pattern of its branches (9). Another study reported a similar case and they stated that the occurrence of the reversed position of ICA and ECA in adults were more normally seen on the right side than the left one (10). Ito H et al., (2006) also mentioned about the reversed position of these vessel in the literature. It was noticed 6.3% of cases with reversed position of ICA and ECA and it was also observed in all reversed cases, the superior thyroid, lingual and facial arteries arose from the posterior aspect of ECA and later those branches ran forward superficial to ICA (11).

In this study, we noticed the bifurcation of CCA above the cricoid cartilage. Normally CCA bifurcates into ECA and ICA at the superior border of thyroid cartilage. The thyroid cartilage is situated at the C4 and C5 level, aids as a noticeable anatomical landmark for surgical procedures (12). The bifurcation of CCA can occur as high at the level of hyoid bone or even at the level of styloid process, or low at the cricoid cartilage (13).

Bifurcation point of CCA represents the embryological budding point of the ECA from the CCA. Usually there is a pair of third aortic arches and dorsal aorta on both left and right of early embryo. Later in the embryonic life dorsal aorta fuses below the level of aortic arches. Since arterial system more predominant on the left and venous system dominant on the right side of the developing embryo the remaining part of the right dorsal aorta which was below the fourth aortic arch later

degenerates. The left dorsal aorta simply continues with the left side arch of aorta as the descending aorta. Right dorsal aorta also contributes to certain parts of the right subclavian artery. Thus, the Anatomical variation in the right subclavian artery must be looked for to check any variation of the right dorsal aorta. Behzad Saberi (2020) described specific differences in the morphology of ICA, and it might undergo variations during the embryological development (14). The ICA normally passes straight in the neck and some of its variations are kinking, coiling and tortuosity (15).

### Conclusion:

The variant anatomy of the arterial vessels is of profound surgical relevance. Uncommon course of these vessels in unanticipated condition could lead to the unintentional injury to these structures and added complications. Understanding the vascular anatomy of the neck is also vital in precise interpretation of radiological images.

### References:

1. VR Anu, MM Pai, R Rajalakshmi, VP Latha, V Rajanigandha, S D Costa. Clinically-relevant variations of the carotid arterial system. *Singapore Med J* 2007; 48 (6): 566-569
2. Sinnatamby, C.S. Last's anatomy: regional and applied. 11th ed, Edinburgh: Elsevier Health Sciences. 2006: Pg 354
3. Devadas, D. Pillay, M. Sukumaran, T.T. A cadaveric study on variations in branching pattern of external carotid artery *Anat Cell Biol* 2018; 51:225-231
4. Baz, R.A.; Scheau, C.; Niscoveanu, C.; Bordei, P. Morphometry of the Entire Internal Carotid Artery on CT Angiography. *Medicina* 2021;57: 832. <https://doi.org/10.3390/medicina57080832>
5. Sadler, T.W., Langman's Medical Embryology. 9<sup>th</sup> ed, Lippincott Williams and Wilkins. (2012) ; pg 256 ISBN-978-4511-132-6
6. Rajendra B. Metgudmath, Anjali R. Metgudmath, Vinita V. Metgudmath, and Vivek Jainkeri. Variations of the Cervical Internal Carotid Artery. *Indian J Otolaryngol Head Neck Surg*. 2013; 65(3): 210–213.
7. Masaki Ito 1 2, Yoshimasa Niiya 3, Masashi Kojima 4, Hiroyuki Itosaka 3, Motoyuki Iwasaki 3, Ken Kazumata 5, Shoji Mabuchi 3, Kiyohiro Houkin 5. Lateral Position of the External Carotid Artery: A Rare Variation to Be Recognized During Carotid Endarterectomy. *Acta Neurochir Suppl* 2016; 123:115-22. doi: 10.1007/978-3-319-29887-0\_16.
8. Pasaoglu Lale, Ugur Toprak, Gökhan YagJz, Tunca Kaya, and SadJk Ahmet UyanJk. Variations in the Branching Pattern of the Aortic Arch Detected with Computerized Tomography Angiography. *Hindawi Publishing Corporation. Advances in Radiology*. 2014; 2014: Article ID 969728, 6 pages. <http://dx.doi.org/10.1155/2014/969728>
9. Gaikwad MR, Patil KS, Tirpude AP, Wakode NS. Anomalous High Transverse Course of Brachiocephalic Trunk and its Clinical Significance: A Rare Case Report. *J Clin Diagn Res* 2018; 12(3): AD03-AD04. DOI: 10.7860/JCDR/2018/34387.11278.
10. Kirchgessner A. Lateral external carotid artery and linguofacial trunk: a rare anatomic variant. *MOJ Anat & Physiol*. 2015;1(1):1–3. DOI: 10.15406/mojap.2015.01.00001
11. Ito H, Mataga I, Kageyama I, Konayashi K. Clinical anatomy in the neck region--the position of external and internal carotid arteries may be reversed. *Okajimas Folia Anat Jpn*. 2006; 82:157–168.doi:10.2535/ofaj.82.157
12. Y. Yan, C. Huang, Q Jiang, Y Yang, Lin, Ke Wang, X Li, H. Zheng and X. Wang. Normal radiological anatomy of thyroid cartilage in 600 Chinese individuals: implications for anterior cervical spine surgery. *Journal of Orthopaedic Surgery and Research* 2018; 13:31 8 pages. DOI 10.1186/s13018-018-0728-y
13. Woldeyes DH. Anatomical Variations of the Common Carotid Artery Bifurcations in Relation to the Cervical Vertebrae in Ethiopia. *Anat Physiol* 2014; 4: 143. doi:10.4172/2161-0940.1000143
14. Behzad Saberi. Review on Surgical Anatomy of the Segments of the Internal Carotid Artery. *Archives of Orthopedics and Rheumatology*. 2020; 3(1): 16-17.
15. Simona Sacco MD, Rocco Totaro MD, Massimo Baldassarre MD, Antonio Carolei. Morphological variations of the internal carotid artery: Prevalence, characteristics and association with cerebrovascular disease. *Int J Angiol*. 2007; 16(2): 59-61